

# PLAGUE IMPORTANT FLEAS AND MAMMALS IN UTAH AND THE WESTERN UNITED STATES<sup>1</sup>

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In recent years increased interest has been shown toward those arthropods which are capable<sup>2</sup> and potential<sup>3</sup> vectors of diseases to man and animals closely associated with man. Although outbreaks of human plague in the United States have never been of such disastrous proportions as those in Europe and Asia, there has been continued concern over its presence in sylvatic form since its discovery in rats at San Francisco in 1900. Various workers have implicated more than sixty species and subspecies of fleas with human and sylvatic plague throughout the world. Of this number, over forty-five species and subspecies are known to occur in the United States as obligate or facultative parasites of birds and mammals. Although much work has been done, still relatively little is known concerning the disease transmission potentialities of these species of fleas and their ecological relationships to native mammals and birds which may serve as reservoirs of sylvatic plague.

This study was initiated for three major reasons: (1) to bring together the scattered data from the literature concerning plague important fleas and their hosts, (2) to add to the knowledge concerning the host-flea relationships, and (3) to determine the geographic distribution of medically important species of fleas in Utah.

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2 "Capable vectors" are herein classified as those fleas which have been found infected with plague bacilli in nature or have been infected under experimental conditions, and are known or have been experimentally shown to be able to transmit the disease either under natural or experimental conditions.

3 "Potential vectors" are those fleas which fall under the same categories of natural or experimental infection as "capable vectors," but are not known or have not been shown to be able to transmit the disease either naturally or under experimental conditions.

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In the western United States more than sixty-five species and subspecies of rodents and lagomorphs have been shown to harbor plague bacilli in their body tissues or have acted as hosts for fleas infected with plague. Following is a list of mammals which have been reported as having plague-infected tissue, or have acted as hosts for plague-infected fleas. These reports were taken from the United States Public Health Reports, years 1936 to 1950 inclusive, from Mohr (1948), and from Ecke and Johnson (1950). The system of taxonomy followed is that of Anthony (1928), Hall (1946), and Howell (1938).

#### PLAGUE IMPORTANT MAMMALS IN THE WESTERN UNITED STATES

<i>Citellus armatus</i> (Kennicott)	<i>Dipodomys ordii ordii</i> Woodhouse
<i>C. beecheyi beecheyi</i> (Richardson)	<i>Eutamias quadivittatus frater</i>
<i>C. beecheyi douglasii</i> Richardson	(Allen)
<i>C. beecheyi fisheri</i> Merriam	<i>E. minimus</i> ssp.
<i>C. beecheyi nudipes</i> Huey	<i>Glaucomys sabrinus lascivus</i>
<i>C. beldingi oregonus</i> (Merriam)	(Bangs)
<i>C. columbianus columbianus</i> (Ord)	<i>Lagurus curtatus</i> ssp.
<i>C. columbianus ruficaudus</i> Howell	<i>Lepus californicus</i> ssp.
<i>C. idahoensis</i> Merriam	<i>Marmota flaviventer avara</i> (Bangs)
<i>C. lateralis chrysodeirus</i> (Merriam)	<i>M. flaviventer engelhardti</i> (Allen)
<i>C. mexicanus parvidens</i> (Mearns)	<i>M. flaviventer flaviventer</i>
<i>C. richardsonii elegans</i> (Kennicott)	(Audubon & Bachman)
<i>C. richardsonii nevadensis</i> Howell	<i>M. flaviventer nosophora</i> Howell
<i>C. richardsonii richardsonii</i> (Sabine)	<i>Microtus californicus</i> ssp.
<i>C. spilosoma major</i> (Merriam)	<i>M. montanus</i> ssp.
<i>C. townsendii mollis</i> (Kennicott)	<i>M. nanus</i> ssp.
<i>C. tridecemlineatus</i> ssp.	<i>M. townsendii</i> (Bachman)
<i>C. variegatus grammurus</i> (Say)	<i>Mus musculus</i> ssp.
<i>C. variegatus utah</i> Merriam	<i>Mustela</i> sp.
<i>C. washingtoni loringi</i> Howell	<i>Neotoma albigula</i> ssp.
<i>C. washingtoni washingtoni</i> Howell	<i>N. cinerea occidentalis</i> (Baird)
<i>Cynomys gunnisoni gunnisoni</i>	<i>N. fuscipes mohavensis</i> Elliot
(Baird)	<i>N. lepida intermedia</i> (?)
<i>C. gunnisoni zuniensis</i> Hollister	<i>N. lepida lepida</i> Thomas
<i>C. leucurus</i> Merriam	<i>N. micropus</i> ssp.
<i>C. ludovicianus arizonensis</i> Mearns	<i>Onychomys leucogaster</i> ssp.
<i>C. parvidens</i> Allen	<i>O. torridus</i> ssp.
	<i>Oryzomys</i> sp.

Perognathus sp.	Reithrodontomys megalotis ssp.
Peromyscus boylii ssp.	Sigmodon hispidus ssp.
P. leucopus ssp.	Sylvilagus auduboni ssp.
P. maniculatus ssp.	S. bachmani ssp.
P. truei gilberti Allen	S. nuttallii nuttallii (Bachman)
P. truei truei (Shufeldt)	Tamiasciurus douglasii albolim-
Rattus norvegicus (Erxleben)	batus (Allen)
R. rattus alexandrinus (Geoffroy)	Taxidea taxus neglecta (Mearns)
R. rattus rattus (Linnaeus)	Thomomys talpoides ssp.

In Utah, sylvatic plague was first discovered in 1936. Since that time it is believed to have occurred in thirteen of the twenty-nine counties implicating six species of rodents. Implication of these rodents was based on the identification of plague bacilli in the tissues of the animal, or fleas collected from the animal. Following is a listing of the counties, the implicated animals, and the dates of known occurrences of the disease in Utah.

Beaver County: *Citellus variegatus*, July and August, 1936  
*Marmota flaviventer*, July, 1936

Sevier County: *Citellus variegatus*, July, 1936  
*C. armatus*, May, 1949

Garfield County: *Cynomys parvidens*, August, 1936

Morgan County: *Citellus variegatus*, August, 1937

Kane County: *Neotoma lepida*, May, 1938

Rich County: *Citellus armatus*, July, 1938

Wasatch County: *C. armatus*, August, 1937 and June, 1938

Salt Lake County: *C. variegatus*, Sept., 1948 and March, 1949  
*Peromyscus maniculatus*, Sept., 1948

Millard County: In late November or early December of 1939, a man supposedly contracted plague from skinning a coyote. (From conversation with residents who remember the case, the writer has strong reason to believe that the man had some other disease contracted from some other source).

Weber and Iron Counties: The Communicable Disease Center Bulletin (1948) lists plague as having occurred in these counties, but gives no specific data of date, host, or locality.

Grand and San Juan Counties: During 1949 a hyper-epizootic occurred among prairie dog colonies in these counties. However, no evidence was found to indicate sylvatic plague as the cause of the decrease in population.

Thirty-two species and subspecies of fleas which have been implicated with plague in the western United States are known to occur in Utah. Eleven of these are herein listed as potential vectors, and twenty-one are listed as capable vectors. Following is the known

distribution of these fleas in Utah. All collection records are listed by county. The plague transmission potentiality of each species is given following the name of the species of flea.

- Athyloceras multidentatus* (C. Fox 1909) — Capable Vector  
Salt Lake, Utah
- Catallagia decipiens* Rothschild 1915 — Potential Vector  
Cache, Davis, Salt Lake, Uintah, Utah, Wasatch
- Ctenocephalides felis felis* (Bouche 1835) — Capable Vector  
Salt Lake
- Dermanis montanus* (Baker 1895) — Capable Vector  
Cache, Davis, Emery, Grand, Kane, Salt Lake, San Juan, Sanpete, Utah, Washington, Wayne, Weber
- Echinophaga gallinacea* (Westwood 1875) — Capable Vector  
Grand, San Juan, Washington
- Epididia wennmanni* (Rothschild 1904) — Potential Vector  
Cache, Salt Lake, Utah
- Foxella ignota* ssp. — Potential Vector  
Beaver, Box Elder, Cache, Emery, Grand, Iron, Juab, Millard, Salt Lake, San Juan, Sevier, Tooele, Utah
- Hoplopsyllus affinis* (Baker 1904) — Potential Vector  
Beaver, Garfield, Iron, Kane, San Juan, Sevier, Washington
- Hoplopsyllus anomalus* (Baker 1904) — Capable Vector  
Beaver, Cache, Davis, Emery, Garfield, Grand, Iron, Juab, Kane, Millard, Morgan, Rich, Salt Lake, San Juan, Sanpete, Sevier, Tooele, Uintah, Utah, Washington, Wayne, Weber.
- Hystriochopsylla gigas dippei* Rothschild 1902 — Capable Vector  
Box Elder, Cache, Duchesne, Iron, Salt Lake, Sevier, Summit, Uintah, Utah, Wasatch
- Malaraeus telchinum* (Rothschild 1905) — Capable Vector  
Box Elder, Cache, Davis, Garfield, Millard, Salt Lake, Utah
- Megabothris abantis* (Rothschild 1905) — Capable Vector  
Cache, Daggett, Salt Lake, Uintah, Utah
- Megarhthoglossus divisus divisus* (Baker 1895) — Potential Vector  
Cache, Iron
- Monopsyllus eumolpi eumolpi* (Rothschild 1905) — Capable Vector  
Box Elder, Cache, Davis, Salt Lake, Sevier, Utah, Weber
- Monopsyllus wagneri wagneri* (Baker 1904) — Potential Vector  
Beaver, Box Elder, Cache, Davis, Garfield, Grand, Kane, Millard, Salt Lake, San Juan, Sevier, Tooele, Uintah, Utah, Wasatch, Weber
- Neopsylla inopina* Rothschild 1915 — Potential Vector  
Cache, Salt Lake, Summit, Wasatch, Weber
- Nosopsyllus fasciatus* (Bosc 1801) — Capable Vector  
Salt Lake, Utah
- Opisocrostitis hirsutus* (Baker 1895) — Capable Vector  
Carbon, Daggett, Duchesne, Emery, Garfield, Iron, Kane, Millard, Rich, San Juan, Sevier, Uintah, Wayne
- Opisocrostitis labis* (Jordan and Rothschild 1922) — Capable Vector  
Beaver, Daggett, Millard, Rich, Sevier, Summit
- Opisocrostitis tuberculatus cynomuris* Jellison 1939 — Potential Vector  
Iron, Salt Lake, Weber
- Opisocrostitis tuberculatus tuberculatus* (Baker 1904) — Capable Vector  
Beaver, Cache, Duchesne, Millard, Rich, Salt Lake, Summit, Utah, Weber
- Orchopeas sexdentatus agilis* (Rothschild 1905) — Potential Vector  
Beaver, Cache, Grand, Iron, Kane, Millard, Utah, Washington
- Orchopeas sexdentatus nevadensis* (Jordan 1929) — Potential Vector  
Kane
- Oropsylla idahoensis* (Baker 1904) — Capable Vector  
Beaver, Box Elder, Cache, Duchesne, Emery, Garfield, Iron, Kane,

- Morgan, Rich, Salt Lake, Sanpete, Sevier, Summit, Uintah, Utah, Wasatch, Weber
- Pulex irritans* (Linnaeus 1758) — Capable Vector  
Carbon, Duchesne, Emery, Millard, Summit, Uintah, Washington, Weber
- Thrassis acamantis* (Rothschild 1905) — Capable Vector  
Duchesne, Sevier
- Thrassis arizonensis arizonensis* (Baker 1898) — Capable Vector  
Cache
- Thrassis francisi* (C. Fox 1927) — Capable Vector  
Beaver, Box Elder, Millard, Rich, Salt Lake, Sanpete, Sevier, Tooele, Utah, Wasatch, Weber
- Thrassis howelli howelli* (Jordan 1925) — Capable Vector  
Salt Lake
- Thrassis pandorae* Jellison 1937 — Capable Vector  
Box Elder, Cache, Daggett, Davis, Duchesne, Emery, Morgan, Piute, Rich, Salt Lake, Sanpete, Sevier, Summit, Utah, Wasatch, Weber
- Thrassis petiolatus* (Baker 1904) — Potential Vector  
Salt Lake
- Xenopsylla cheopis* (Rothschild 1903) — Capable Vector  
Salt Lake

## FLEA-HOST ASSOCIATIONS KNOWN TO OCCUR IN UTAH

### ATYPHLOCERAS MULTIDENTATUS

*Neotoma cinerea* *Peromyscus maniculatus*

### CATALLAGIA DECIPIENS

*Citellus variegatus* *Peromyscus* sp.  
*Eutamias quadrivittatus* *Phenacomys intermedius*  
*Microtus montanus* *Sorex* sp.  
*Microtus* sp. *Sylvilagus nuttallii*  
*Neotoma cinerea* (nest) *Thomomys talpoides*  
*Peromyscus maniculatus* *Zapus princeps*

### CTENOCEPHALIDES FELIS FELIS

*Canis familiaris* *Felis domestica*

### DIAMANUS MONTANUS

*Citellus armatus* *Marmota flaviventer*  
*C. lateralis* *Mustela frenata*  
*C. leucurus* *Neotoma cinerea*  
*C. townsendii* *N. cinerea* (nest)  
*C. variegatus* *Neotoma* sp.  
*Citellus* sp. *Peromyscus maniculatus*  
*Cynomys gunnisoni* *Rattus norvegicus*  
*C. leucurus* *Spilogale saxatilis*  
*C. parvidens* *Sylvilagus idahoensis*  
*Dipodomys ordii* *Sylvilagus* sp.  
*Eutamias* sp. *Thomomys bottae*  
*Lepus californicus*

### ECHIDNOPHAGA GALLINACEA

*Citellus leucurus* *Neotoma lepida*  
*C. variegatus* *Neotoma* sp.  
*Dipodomys merriami* *Sylvilagus audubonii*

## EPITEDIA WENMANNI

Microtus montanus	Peromyscus maniculatus
M. pennsylvanicus	P. maniculatus (nest)
Mus musculus	

## FOXELLA IGNOTA

Citellus variegatus	Peromyscus sp.
Clethrionomys gapperi	Rattus norvegicus
Mustela arizonensis	Sylvilagus audubonii
M. frenata	Thomomys bottae
Perognathus parvus	T. perpallidus
Perognathus sp.	T. talpoides
Peromyscus maniculatus	Thomomys sp.

## HOPLOPSYLLUS AFFINIS

Lepus californicus	Sylvilagus sp.
Sylvilagus audubonii	

## HOPLOPSYLLUS ANOMALUS

Citellus grammurus	Marmota flaviventer
C. lateralis	Microtus montanus
C. leucurus	M. pennsylvanicus
C. townsendii	Mustela frenata
C. variegatus	Onychomys leucogaster
Cynomys leucurus	Peromyscus sp.
C. parvidens	Spilogale saxatilis
Eutamias sp.	Sylvilagus sp.

## HYSTRICHOPSYLLA GIGAS DIPPIEI

Citellus armatus	Peromyscus boylii
C. lateralis	P. maniculatus
Clethrionomys sp.	Phenacomys intermedius
Marmota flaviventer	Tamiasciurus hudsonicus
Microtus montanus	Tamiasciurus sp.
Microtus sp.	Zapus princeps
Neotoma cinerea	

## MALARAEUS TELCHINUM

Microtus montanus	P. maniculatus
Neotoma sp.	P. truei
Peromyscus boylii	Peromyscus sp.

## MEGABOTHRIS ABANTIS

Citellus armatus	Peromyscus maniculatus
Clethrionomys gapperi	Phenacomys intermedius
Microtus longicaudus	Rattus norvegicus
M. montanus	Zapus princeps
Microtus sp.	

## MEGARTHROGLOSSUS DIVIUS DIVIUS

Neotoma cinerea	Tamiasciurus fremonti
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## MONOPSYLLUS EUMOLPI EUMOLPI

Citellus armatus	Glaucomys sabrinus
Eutamias minimus	Microtus montanus
E. pictus	Peromyscus boylii
E. quadrivittatus	P. maniculatus
Eutamias sp.	Reithrodontomys megalotis

## MONOPSYLLUS WAGNERI WAGNERI

Bubo virginianus	Mustela arizonensis
Citellus armatus	M. frenata
C. lateralis	Mustela sp.
C. townsendii	Neotoma lepida
C. variegatus	N. stephensi
Clethrionomys gapperi	Neotoma sp.
Cynomys leucurus	Ochotona princeps
Dipodomys ordii	Onychomys leucogaster
Dipodomys sp.	Peromyscus crinitus
Eutamias minimus	P. maniculatus
E. quadrivittatus	P. maniculatus (nest)
Lepus californicus	P. truei
Microtus macropus	Peromyscus sp.
M. montanus	Rattus norvegicus
Microtus sp.	Reithrodontomys megalotis
Mus musculus	Sylvilagus audubonii

## NEOPSYLLA INOPINA

Citellus armatus

## NOSOPSYLLUS FASCIATUS

Citellus armatus	Mustela frenata
C. variegatus	Peromyscus maniculatus
Microtus montanus	Phenacomys intermedius
M. pennsylvanicus	Rattus norvegicus
Mus musculus	R. rattus

## OPISOCROSTIS HIRSUTUS

Citellus armatus	Dipodomys ordii
C. lateralis	Lepus californicus
Cynomys gunnisoni	Mustela sp.
C. parvidens	Neotoma sp.
Cynomys sp.	"Rabbit" sp.

## OPISOCROSTIS LABIS

Citellus armatus	Cynomys leucurus
C. townsendii	

## OPISOCROSTIS TUBERCULATUS CYNOMURIS

Citellus armatus	Cynomys parvidens
C. variegatus	

## OPISOCROSTIS TUBERCULATUS TUBERCULATUS

Citellus armatus	C. variegatus
C. leucurus	Cynomys leucurus
C. mollis	Marmota flaviventer
C. townsendii	Lepus californicus

## ORCHOPEAS SEXDENTATUS AGILIS

Neotoma cinerea	Peromyscus crinitus
N. cinerea (nest)	P. maniculatus
N. desertorum	Reithrodontomys megalotis
N. lepida	

## ORCHOPEAS SEXDENTATUS NEVADENSIS

Neotoma desertorum	N. lepida
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## OROPSYLLA IDAHOENSIS

Citellus armatus	Falco mexicanus
C. castanurus	Marmota flaviventer
C. lateralis	Mustela arizonensis
C. leucurus	Mustela sp.
C. townsendii	Peromyscus maniculatus
C. variegatus	Sylvilagus sp.
Cynomys parvidens	Thomomys sp.
Eutamias sp.	

## PULEX IRRITANS

Canis latrans	Speotyto cunicularia
Cynomys leucurus	S. cunicularia (nest)
Cynomys sp.	

## THRASSIS ACAMANTIS

Marmota flaviventer

## THRASSIS ARIZONENSIS ARIZONENSIS

Citellus armatus

## THRASSIS FRANCISI

Citellus armatus	Cynomys leucurus
C. leucurus	Thomomys sp.
C. townsendii	

## THRASSIS HOWELLI HOWELLI

Citellus variegatus	Marmota flaviventer
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## THRASSIS PANDORAE

Citellus armatus	Eutamias sp.
C. mollis	Marmota flaviventer
C. townsendii	Peromyscus sp.
C. variegatus	Thomomys sp.
Cynomys leucurus	

## THRASSIS PETIOLATUS

Citellus armatus

## XENOPSYLLA CHEOPIS

Rattus norvegicus	R. rattus
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## SELECTED REFERENCES

- Anthony, H. E., 1928. Field Book of North American Mammals. New York: G. P. Putnam's Sons.
- Burroughs, A. L., 1944. "The flea *Malariaeus telchinum* a vector of *P. pestis*." Proc. Soc. Exp. Biol. and Med. 55:10-11.
- , 1947. "The vector efficiency of nine species of fleas compared with *Xenopsylla cheopis*." Jour. Hygiene 45(3):371-96.
- Communicable Disease Center Bulletin. 1948. Fed. Sec. Agency, Pub. Health Service, CDC, Atlanta, Georgia. July, August, Sept. Issue.



- Ecke, D. H., and C. W. Johnson, 1950. "Sylvatic plague in Park County, Colorado." Trans. XV North Amer. Wildlife Conf., March 6, 7, 9. Pp. 191-7.
- Eskey, C. R., and V. H. Haas, 1939. "Plague in the western part of the United States. Infection in rodents, experimental transmission by fleas, and inoculation tests for infection." Public Health Reports 54(32):1467-81.
- Hall, E. R., 1946. Mammals of Nevada. Berkeley and Los Angeles: University of Calif. Press.
- Howell, A. H., 1938. Revision of the North American Ground Squirrels. U. S. Dept. of Agric., Bur. Biol. Survey, N. Amer. Fauna, No. 56.
- Hubbard, C. A., 1947. Fleas of Western North America. Ames, Iowa: Iowa State College Press.
- Mohr, C. O., 1948. "Domestic rats, fleas and native rodents in relation to plague in the United States." C.D.C. Bulletin, Fed. Sec. Agency, Atlanta, Ga.
- Prince, F. M., 1943. "Report on the fleas *Opisocrostitis bruneri* (Baker) and *Thrassis bacchi* (Roths.) as vectors of plague." Public Health Reports 58(27):1013-16.
- Stanford, J. S., 1944. "More Utah Siphonaptera." Proc. Utah Acad. Sci., Arts and Letters, Vol. 19 and 20:173-8.
- Stark, H. E., 1948. "Fleas of Utah." Unpublished Master's Thesis, Dept. of Biology, Univ. of Utah, Salt Lake City, Utah.
- Tipton, V. J., 1950. "New Distributional Records for Utah Siphonaptera." Great Basin Nat. 10(1-4):62-65.
- U. S. Public Health Reports. Federal Sec. Agency, Vols. 51(30) to 65(39), 1936-1950.
- Verjbitski, D. T., 1908. "The part played by insects in the epidemiology of plague." (translated from Russian) Jour. Hygiene 8:162-208.
- Wayson, N. E., 1947. "Plague - Field surveys in western United States during ten years (1936-1945)." Public Health Reports 62(22):780-91.
- Wheeler, C. M., J. R. Douglas, and F. C. Evans. 1941. "The role of the burrowing owl and the sticktight flea in the spread of plague." Science 94:560-61.